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ATOMIC & MOLECULAR ASTROPHYSICS LABORATORY

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**PRELIMINARY**
**EXPERIMENT REQUIREMENTS DOCUMENT**
**FOR**
**SOLAR AND TERRESTRIAL ATMOSPHERES SPECTROMETER**
**(STAS)**

NASW-3940

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# 1. GENERAL INFORMATION

## 1.1 Summary of Experiment Objectives

The principal scientific objective of the Solar and Terrestrial Atmospheres Spectrometer (STAS) project is the measurement of the absolute ultraviolet solar spectral irradiance with.

(1) resolution of better than 15 mÅ, and
(2) absolute irradiance uncertainty at the state of the art (less than or equal to 3%).

There is considerable uncertainty in the absolute value of the solar ultraviolet irradiance and in its variability, especially at high resolution. High measurement accuracy coupled with high spectral resolution are necessary to identify the nature of the radiation, its variability, and to identify solar processes which may cause these changes.

Solar radiation between 1200 Å and 3600 Å dominates the photochemistry of the mesosphere and stratosphere. Photodissociation of molecular oxygen is the principal source of the odd oxygen atoms that lead to the formation of ozone. Ozone is itself destroyed by the absorption of solar photons. Important major and minor constituents of the atmosphere are also destroyed by photodissociation and by discrete absorption followed by predissociation.

Some important minor species, such as NO, show very complex and fundamentally narrow structure in their photodestruction cross sections, especially in the region of the Schumann-Runge bands of $O_2$. Understanding of the photochemical processes in the terrestrial atmosphere requires knowledge of both the cross sections and of the solar spectrum with the highest possible resolution and accuracy.

## 1.2 Instrument Characteristics

The STAS is a spectrometer with very high (10 mÅ) spectral resolution and radiometric accuracy (3% absolute, 1% relative) for the 1200 to 3600 Å wavelength range. The optical subsystem comprises a three-meter focal length Czerny-Turner monochromator with off-axis paraboloidal mirrors used in a coma-correcting configuration. The 3600 line $mm^{-1}$ diffraction grating rotates to select a wavelength range, which is scanned in the focal plane by a scanning slit and photomultiplier. A wide bandpass, grating premonochromator and filters can be moved into the light path in front of the main monochromator to reduce out-of-band scattered light Standard

light sources are carried in the instrument for monitoring the radiometric calibration of STAS during testing and in flight.

A system level block diagram is presented in Figure 1 2-1. The instrument is in three packages; the Optics Module (ID No. 1), Electronics A (ID No. 2), and Electronics B (ID No. 3). The Remote Acquisition Unit (RAU) is a NASA-provided package (ID No 4).

The mechanical subsystem of the Optics Module (Figure 1 2-2) includes a trusswork structure of graphite-epoxy square tubing for near zero thermal expansion. This structure is the optical bench to which the instrument components are attached. There are nine mechanisms

Front aperture door,
Premonochromator and calibration lamp positioner,
Filter selector,
Slit selectors (three),
Grating drives (two),
Focal plane scanner.

The structure is enclosed in a box of aluminum honeycomb panels to exclude light and contaminants. The structure is fastened by a three point kinematic mount to the Instrument Pointing System (IPS). The enclosure fastens at the feet of the mounting so as not to bear upon the optical bench.

The electrical system block diagram is shown in Figure 1.2-3. The detectors are a pair of photomultiplier tubes (PMT) with independent event conditioning electronics. The detector events are counted and then data are formatted by a microprocessor system before being sent to the Spacelab Experiment Computer (EC). Pulse heights are also sampled and measured, at a low housekeeping rate, to help monitor system performance A system of 5 calibration lamps [2 $D_2$ lamps and 2 tungsten-halogen lamps and a Ne-Pt hollow cathode] is provided, each individually selectable and each with its own specialized power supply. Nine different mechanisms are positioned and monitored by special drive systems, all under control of the microprocessor Temperature of the optical bench is closely controlled by a system of 6 temperature controllers. The power bus is 28 Vdc from the Spacelab system, this is converted and regulated by a multi-output, low voltage power supply Data from the instrument and commands from the Spacelab experiment computer are routed through a shared experiment RAU mounted on the IPS. Commands are used to set up and to initiate microprocessor controlled exposure sequences, and to control power to the instrument and the temperature controllers. The data rate is low. Science data consists of the event counter contents which are read out after each signal integration time period. The instrument

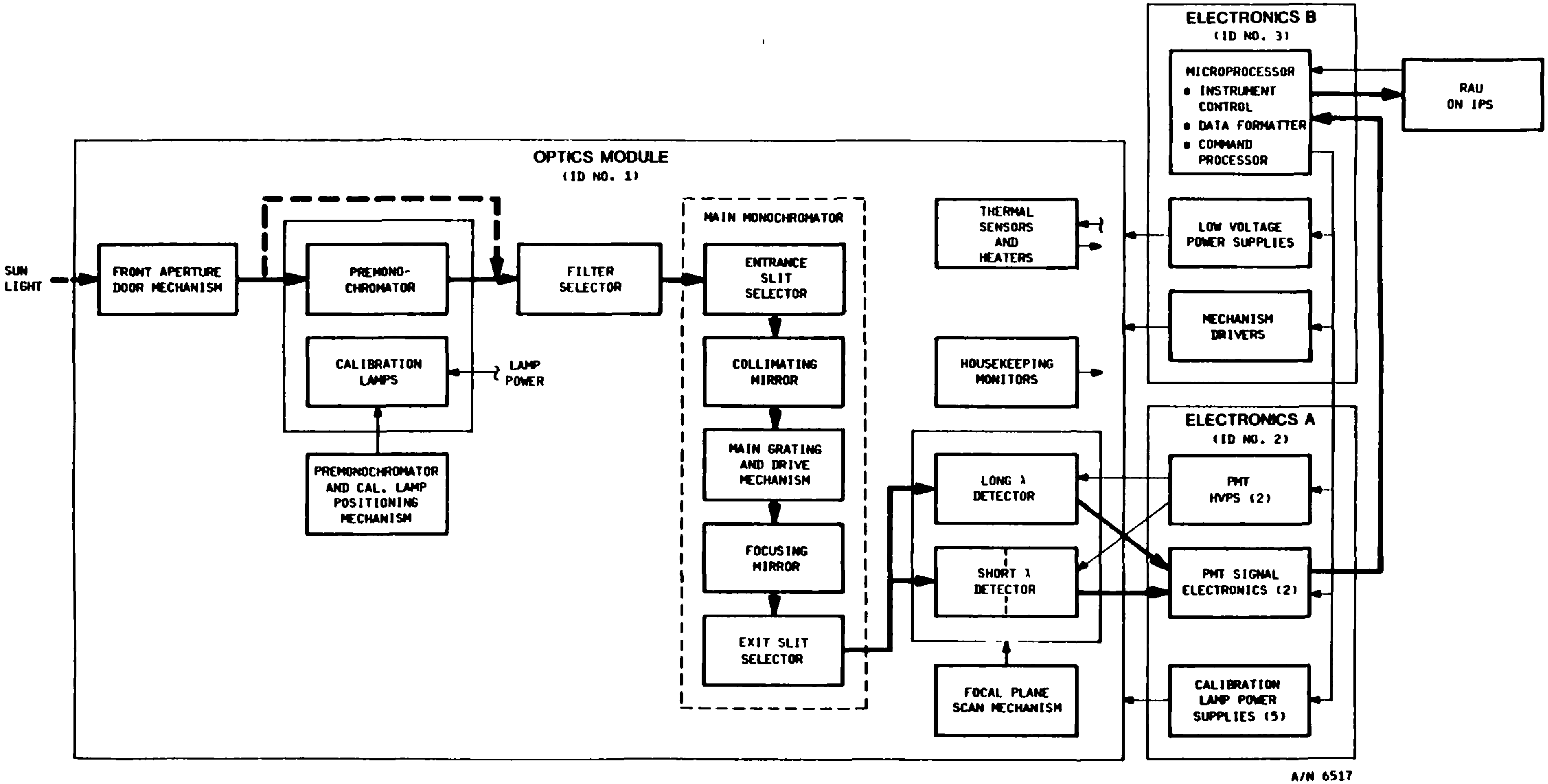


Figure 1.2-1 STAS System Level Functional Block Diagram


NOTES. UNLESS OTHERWISE SPECIFIED
1. SEE BASD DWG 156301 FOR OPTIONAL TELESCOPE
2. PREMONOCHROMATOR GRATING RADIUS = 200 MM
3. MONOCHROMATOR FOCAL LENGTH = 3000 MM
REVISIONS
A REV TELESCOPE PROVISION 85-7-15
B REV TRUSS & MNTG FT LOC 85-11-18
FOLDOUT FRAME
ORIGINAL PAGE IS OF POOR QUALITY
UPPER PMT SELECTION MECH PLATFORM
(ELLIPSOIDAL MIRROR) (OPTIONAL)
(PMT)
(EXIT SLIT)
(FOLDING MIRROR)
(LINEAR ARRAY DETECTOR) (OPTIONAL)
FOCAL PLANE SCAN & PMT SELECTOR DRIVE
MAIN GRATING
F5 ONLY TYP
CZERNY-TURNER MIRRORS
LIGHT BAFFLE
FOLDING MIRROR
N6 EFS TYP
LIGHT BAFFLE
MAIN GRATING DRIVE
F6 ONLY TYP
52.50 (1333.5 MM)
.75 (19.05 MM)
2 FOLDOUT FRAME
FILTER WHEEL ASSY
PREMONOCHROMATOR
CALIBRATION LAMP/ PREMONOCHROMATOR CARROUSEL
SLIT CHANGER
ENTRANCE SLIT
EXIT SLIT
GUSSETS TYP ALL OPTICAL BENCH INTERSECTIONS
N6 EFS TYP
N6 ONLY TYP
KINEMATIC SUPPORT
3 FOLDOUT FRAME
N6 ONLY TYP
4 FOLDOUT FRAME
OPTICAL MOUNT
5 FOLDOUT FRAME
6 FOLDOUT FRAME
1 METER (≈ 0.16 SCALE)
PARTS LIST
Aerospace Systems Division
P. O. Box 1062 Boulder, Colorado 80306
PRIMARY INSTRUMENT CONCEPT-STAS
SIZE J FSCM NO. 13993 DWG NO. 156300 REV B
SCALE 1/2 SHEET 1 OF 1

Figure 1.2-2

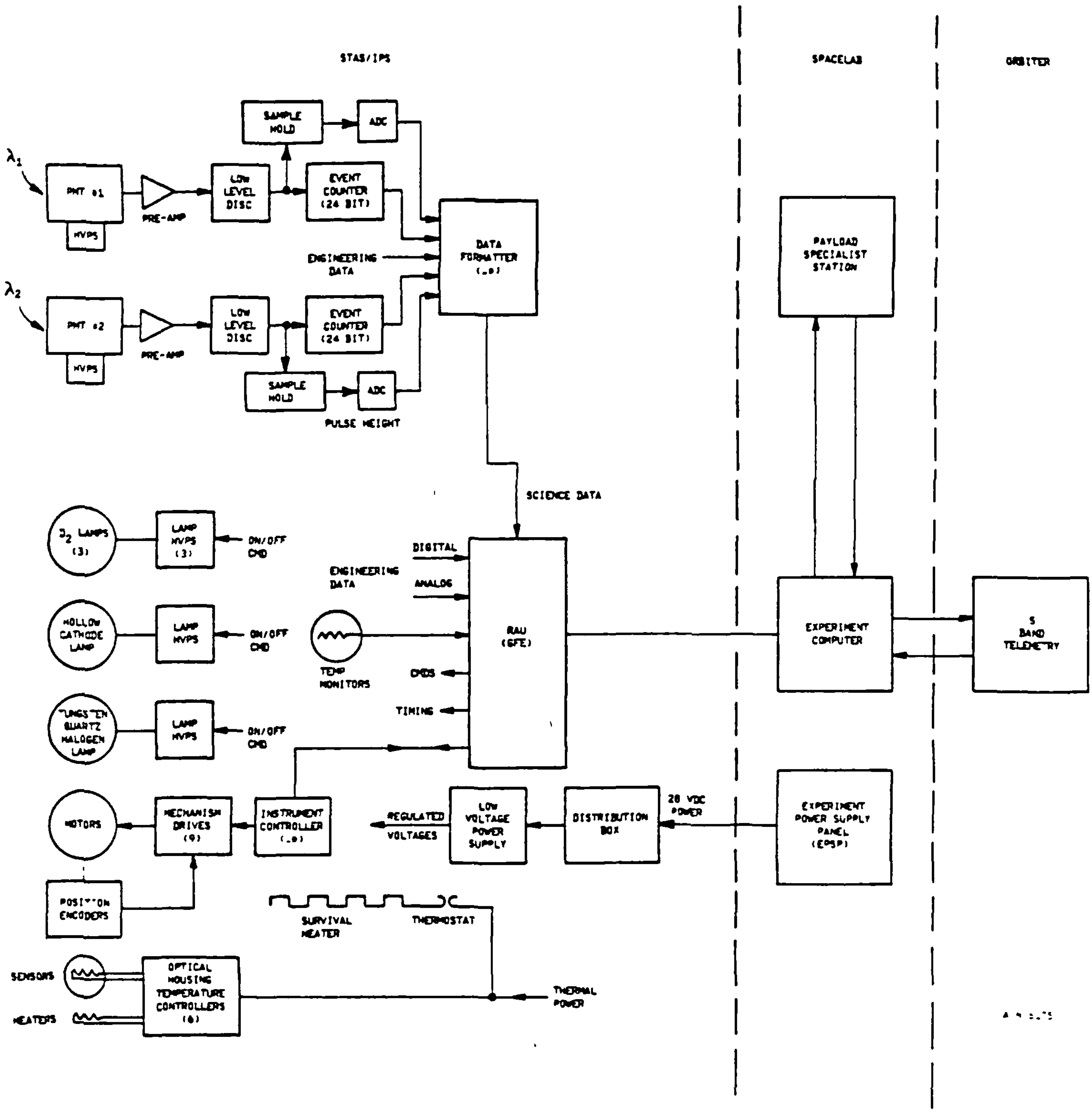


Figure 1.2-3 STAS Electrical System Block Diagram

electronics are packaged in two boxes; Electronics A, containing PMT electronics and lamp power supplies and located near the Optics Module for short wire runs, and Electronics B, containing the instrument controller microprocessor and the mechanism drivers. The spacelab RAU occupies a third box.

The two principal modes of operation are observation and calibration monitoring. For observing, the wavelength range is selected by setting the grating angle for the main monochromator, and for the premonochromator if used. Various filters and slit widths can be selected. The spectrum is scanned by accurately driving the exit slit and photomultiplier linearly in the focal plane. There are two photomultipliers with different photocathode and window combinations for optimum performance at long (1600-3600 Å) and short (1200-1800 Å) wavelengths. Scanning can be done at a constant commandable rate or, in order to improve statistics in the low intensity regions, the scanner can step and hold while each increment is counted to the same total.

The radiometric calibration of the instrument is monitored during orbital night. This monitoring involves the same routines as observing except that one of five calibration lamps is positioned in front of the entrance slit. All operation is under control of the microprocessor, which will contain standard operating routines in memory and will also allow programming of new routines during the mission if required.

Thermal control is by multilayer insulating blankets and heaters under active thermal control on the instrument enclosure. When a mission is assigned and the thermal environment on the IPS is defined, this design may be modified to best suit the actual environment.

## 1.3 Summary of Experimental Observations

The following operational steps must be performed to accomplish the experimental objectives. The STAS operating described in Section 6.1.

I. Launch and Deployment: The STAS experiment will be launched with all power off in the LAUNCH and RE-ENTRY mode. On-orbit, the cargo bay doors will be opened and the IPS will be deployed.

II. Preliminary Functional Checks: Following IPS deployment, STAS will be commanded to a POWER-DOWN mode and engineering functions will be monitored to establish instrument health.

III. On-Orbit Functional Checks: STAS will be commanded to an ON-ORBIT STANDBY mode, power will be applied to the electronics. When the IPS is in a safe orientation, the front aperture door will be opened and vacuum levels will be monitored. The STAS Instrument Controller Microprocessor(ICM) will be loaded from the Mass Memory Unit (MMU) and a functional checkout procedure will be performed at the Payload Operations Control Center (POCC) and at the Aft-Flight Deck (AFD)

IV. Send Observing or Calibration Commands Several 32 word serial command blocks, which provide the STAS with the information needed to run an observational sequence or set of sequences, will be sent to the instrument prior to the beginning of the observing run. This could be done with the instruments in either the ON-ORBIT STANDBY mode or the OBSERVING mode and could be accomplished during either the night or day portions of the orbit. Commands will be verified by the Mission/Payload Specialist or by the STAS Electronic Ground Support Equipment (EGSE) in the POCC. In the event that observing sequence commands cannot be sent, a set of patrol sequences stored in the STAS Read Only Memory (ROM) could be initiated by the Mission/Payload Specialist or ground operator.

VI. Point: STAS will be commanded to an observing mode by the Mission/Payload Specialist via the Spacelab Data Display System DDS) or by the ground operator. The STAS will request pointing at sun-center if the STAS experiment has control of IPS.

VII. Observe or Calibrate: Following pointing verifications, STAS will request an initiation of the observing sequence by the Mission/ Payload Specialist or ground operator.

VIII. On-Orbit Standby: During the night portion of the orbits, STAS will be put in the ON-ORBIT STANDBY mode, or CALIBRATION mode.

IX. Power-Down. Following the observing or calibration period, STAS can be put in a POWER-DOWN mode for about TBD hours to conserve energy The ON-ORBIT STANDBY mode will be required about TBD hours before observations are resumed.

X. Halt: The Mission/Payload Specialist or ground operator will be able to interrupt STAS observations at any time

### 1.4 Mission Characteristics

Any earth orbit above 300 km is satisfactory A minimum of 7 days for experiment operation is highly desirable; therefore a 14-day mission is preferred to insure an acceptable environment during operations. STAS observations would be seriously impeded by contamination clouds, and stray-light levels from scattered solar disk radiation could prohibit measurements. Hence, Orbiter attitudes and orbits requiring frequent thruster firings are undesirable and waste dumps/flash evaporations during STAS observations are unacceptable.

# 2. PHYSICAL AND FUNCTIONAL REQUIREMENTS

## 2.1 Mechanical Interface Requirements

### 2.1.1 Drawings

Figure 2.1.1-1 shows the STAS Optics Module with exterior dimensions, the location of the aperture door and the three mounting feet, the clearance for operation of the aperture door, the field of view (FOV), the mass and the location of the center of mass

There are no radiation sources, pressure vessels, cryogenics, or heat transfer interfaces on STAS.

### 2.1.2 Flight Equipment

See Table 2.1.2-1 for a list of the STAS flight equipment properties. ID No. 1, Optics Module, is the optical bench, optics, mechanisms, and enclosure, and contains as little electronics and wiring as possible ID No. 2, Electronics A, is located close to the Optics Module and contains electronics which should have short connecting lines to the Optics Module. ID No. 3, Electronics B, can be located where convenient on IPS. ID No. 4, the RAU, is Spacelab equipment located on IPS. Cabling, though not yet designed, is allocated 12 kg. Products of inertia are still to be determined because of uncertainty in the location of the centers of gravity of some of the massive mechanisms and components.

### 2.1.3 Alignment Requirements

Table 2.1.3-1 lists the alignment requirements of the STAS with the IPS. There are presently no coalignment requirements. If STAS becomes one of a complement of instruments for coordinated observations, then coalignments may be required.

### 2.1.4 Deployment Requirements

The deployment requirement is that of the IPS to point at the sun during observations There are no deployment requirements for calibration

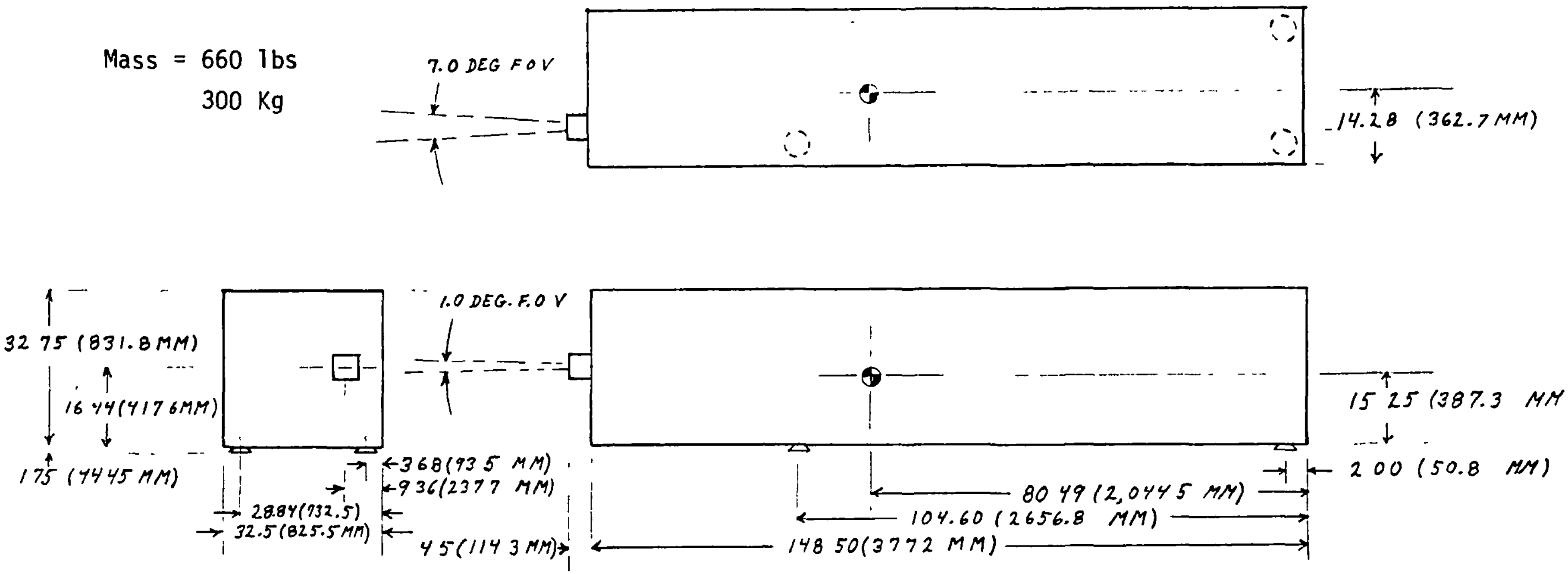


Figure 2.1.1-1 STAS Optics Module: Envelope, Mounting Feet, Center of Gravity, and Field of View.

Table 2.1.2-1
List of Flight Equipment Properties

| | EXPERIMENT TITLE STAS | | | | | | | | DATE April, 1986 | | | REVISION None | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ID NO | EQUIPMENT NOMENCLATURE | MASS Kg | MAJOR DIMENSIONS (CM) L×W×H OR L×DIA | MOUNTING PREFERRED | CENTER OF GRAVITY STATION (MM) | | | MOMENT OF INERTIA ($KgM^2$) | | | PRODUCT OF INERTIA ($KgM^2$) | | |
| | | | | | | X | Y | Z | Ix | Iy | Iz | Ixy | Ixz | Iyz |
| MODULE EQUIPMENT | | | | | | | | | | | | | | |
| PALLET EQUIPMENT | 1 | Optics Module | 300 | 377.2 x 82.6 x 83.2 | IPS | 362 | 387 | 2044 | 410 | 410 | 37.8 | ---- | TBD* | ---- |
| | 2 | Electronics A | 7 5 | 30 x 23 x 15 | IPS, near 1 | ---- | TBD | ---- | .124 | 090 | 065 | ---- | TBD | ---- |
| | 3 | Electronics B | 16.8 | 48 x 23 x 20 | IPS | ---- | TBD | ---- | .516 | .426 | .170 | ---- | TBD | ---- |
| | 4 | RAU | 9 | 42 x 18 x 14 | IPS | ---- | TBD | ---- | 174 | .164 | .043 | ---- | TBD | ---- |
| | | Cable Harness | 12 | | | | | | | | | | | |
| AFT FLIGHT DECK EQUIPMENT | | | | | | | | | | | | | | |
| TOTAL MASS | | | | | | | | | | | | | | |

* The locations of the centers of gravity of major components are not well enough known to make the products meaningful.

Table 2.1.3-1
Alignment Requirements

| EXPERIMENT TITLE: STAS | | | DATE: April, 1986 | REVISION: None | |
|---|---|---|---|---|---|
| ID NUMBER | TYPE OF ALIGNMENT | | ALIGNMENT TOLERANCE (ARC-MIN) | APPLICABILITY | |
| | MEASURED | ACTUAL | | LEVEL IV | ON-ORBIT |
| 1 | | STAS optical reference surface to 1PS optical sensor package | 1 arc min | X | X |

Table 2.1.3-2
Coalignment Requirements

| EXPERIMENT TITLE: STAS | | | DATE: April 1986 | REVISION: None | |
|---|---|---|---|---|---|
| ID NUMBER | COALIGNMENT REQUIRED TO | | COALIGNMENT TOLERANCE (ARC-MIN) | APPLICABILITY | |
| | COMMON REFERENCE | ANOTHER ITEM NUMBER* | | LEVEL IV | ON ORBIT |
| TBD, if STAS becomes one of a complement of instruments for coordinated observations | | | | | |

## 2.2 Pointing Requirements

The pointing requirements are modest because STAS accepts unfocussed sunlight on the entrance slit. The pointing needs only to be sufficient to maintain proper illumination of the optics beyond the slit during observation. These requirements are given in Table 2 2-1. There are no pointing requirements during calibration

## 2.3 Electrical Requirements

### 2.3.1 Power Profiles

A typical power profile is given in Figure 2 3.1-1

### 2.3.2 Connector Requirements

Connector requirements and pin designations will be defined later, in the Implementation Phase.

### 2.3.3 Additional Requirements

The STAS instrument will be grounded to a common spacecraft ground. Electrical and magnetic shielding requirements are TBD.

## 2.4 Thermal Control Requirements

### 2.4.1 Thermal Control Characteristics

It is not known now what the on-orbit local thermal environment for the STAS will be. It will depend on the mission assignment, other instruments on the IPS, and the existence of a Spacelab provided canister and its level of thermal control. Assuming the most difficult thermal environment, i.e., no Spacelab-provided thermal protection or conditioning, the conceptual design includes thermal blanketing and heaters on the Optics Module enclosure. The optics and optical bench should be held to 21 ± 5° C to maintain acceptable performance. NASTRAN computer runs show that 3 3° C/m gradients in the optical bench are acceptable.

Table 2.2-1
Instrument Pointing Requirements

| EXPERIMENT TITLE: STAS | | DATE April 1986 | REVISION: None |
|---|---|---|---|
| REQUIREMENT | PITCH & YAW | ROLL | |
| ACCURACY (arc-sec) | ± 120 | NA | |
| STABILITY (arc-sec/sec) | Not critical. The IPS characteristic of 60 is more than adequate. | NA | |
| KNOWLEDGE OF ACCURACY (arc-sec) | ± 60 | NA | |
| OTHER | | | |

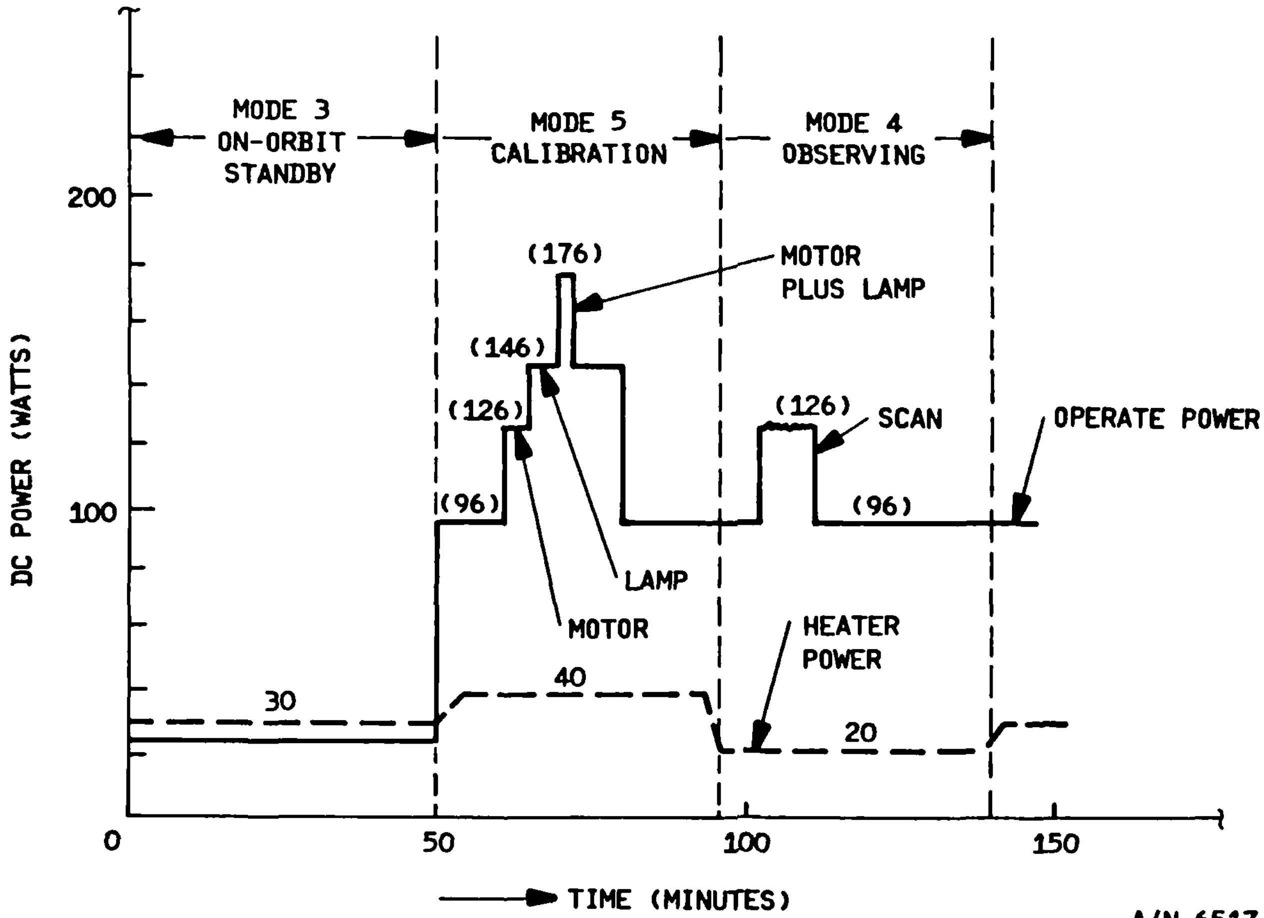


Figure 2.3.1-1  STAS Power Profile

Table 2.3.2-1
Interface Connector Requirements

| EXPERIMENT TITLE: STAS | | DATE April 1986 | REVISION. None |
|---|---|---|---|
| I D. NO. | CONNECTOR NAME CODE | TYPE | FUNCTION |
| | TBD | TBD | TBD |

Table 2.3.2-2
Interface Pin Designations

| EXPERIMENT TITLE: | | | DATE: | REVISION. |
|---|---|---|---|---|
| CONNECTOR | PIN NO. | WIRE TYPE & SIZE | SIGNAL DESCRIPTION | UNIT DESCRIPTION |
| TBD | TBD | TBD | TBD | TBD |

The temperature limits and constraints listed under ID No. 1 in Table 2.4.1-1 are for the interior of the optics module. The thermal interface with whatever accommodates STAS on the IPS should be at 10 ± 5° C to allow proper performance of the STAS thermal control system.

### 2.4.2 Coating and Coverings

Coatings, emittance and absorptance of surfaces will be determined when more is known about the mission conditions. The use of multilayer insulation blankets is assumed

### 2.4.3 Cold Plate Requirements

There is no requirement for a cold plate.

## 2.5 Command and Data Management

### 2.5.1 Command and Data Management System (CDMS) Interface

Table 2.5.1-1 describes the STAS/CDMS interface

### 2.5.2 Experiment Inputs

Table 2.5.2-1 describes the STAS command input requirements

### 2.5.3 Experiments Outputs

Table 2.5.3-1 describes the STAS outputs to the CDMS.

### 2.5.4 Other CDMS

None

Table 2.4.1-1
Thermal Control Characteristics

| EXPERIMENT TITLE: STAS | | | | | | DATE. April 1986 | | REVISION: None | |
|---|---|---|---|---|---|---|---|---|---|
| ID NUMBER | TEMPERATURE LIMITS °C | | | HEAT DISSIPATION* WATTS | | | ALLOWABLE TEMPERATURE CONSTRAINTS | | |
| | OPERATING | NON OPERATING | STANDBY | OPERATING | NON OPERATING | STANDBY | GRADIENTS | LEVEL | TEMP RATE OF CHANGE |
| 1 | +16 to +26** | -40 to +80 | +16 to +26 | | | | 3.3°C/M any direction | 21°C ±5°C operating | ±3°C per 90 min orbital period, operating |
| 2 | 0 to +40 | -40 to +80 | 0 to +40 | | | | | | |
| 3 | 0 to +40 | -40 to +80 | 0 to +40 | | | | | | |
| Total | | | | 116 average | TBD | 55 average | | | |

**Optics and optical bench within the enclosure

*Include heater power

Table 2.4.1-2
Thermal Heating and Cooling Requirements

| EXPERIMENT TITLE: STAS | | | | | | | DATE: April 1986 | | | REVISION: None | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ID NUMBER | AIR COOLING | | | | | | SPACELAB COLD PLATE | | | | SPECIAL COOLING |
| | MAX | | | MIN | | | MAX | | MIN | | |
| | FLOW RATE (CFM) | ΔP | TEMP | FLOW RATE (CFM) | ΔP | TEMP | HEAT REJECTION (WATTS) | TEMP | HEAT REJECTION (WATTS) | TEMP | LAUNCH PAD | POST LANDING |
| 1 | N/A | | | | | | N/A | | | | If necessary to stay within survival limit, <80°C | |
| 2 | N/A | | | | | | N/A | | | | | |
| 3 | N/A | | | | | | N/A | | | | | |

Table 2.5.1-1
Experiment/CDMS Interface

| EXPERIMENT TITLE | DATE | REVISION |
|---|---|---|
| STAS | April 1986 | None |

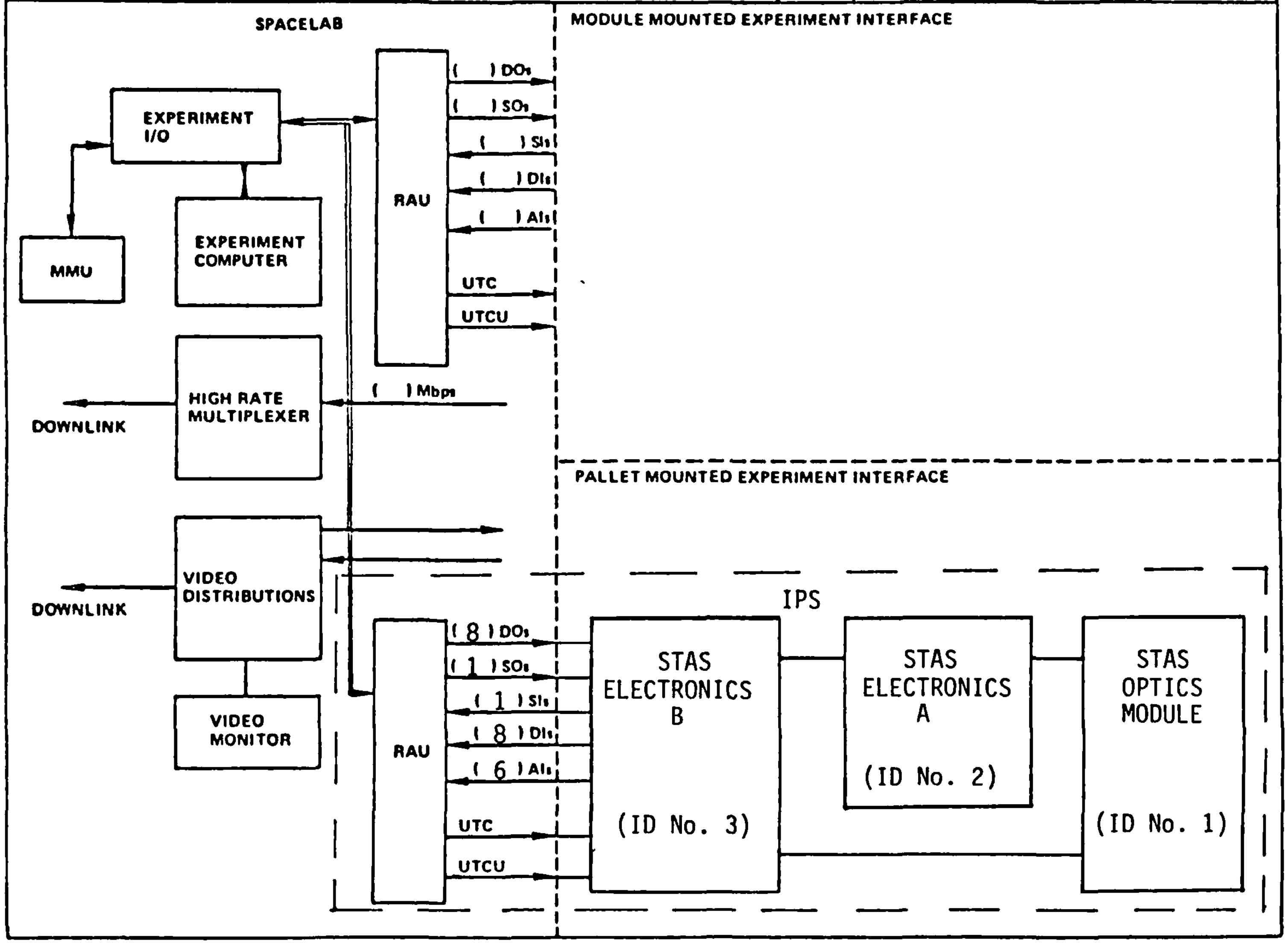

Table 2.5.2-1
Inputs to Experiment

| EXPERIMENT TITLE: STAS | DATE April 1986 | REVISION: None |
|---|---|---|

| INPUT NAME/DESCRIPTION | | FORMAT | SOURCE | SERIAL LENGTH | FREQUENCY |
|---|---|---|---|---|---|
| Quiet Power | on/off | Discrete | KB, GC | 2 bits | once/orbit |
| Motor Power | on/off | | | | |
| Temp Control 1 | en/dis | | | | |
| Temp Control 2 | en/dis | | | | |
| Temp Control 3 | en/dis | | | | |
| Temp Control 4 | en/dis | | | | |
| Temp Control 5 | en/dis | | | | |
| Temp Control 6 | en/dis | | | | |
| SERIAL COMMAND 16 WORDS: | | | | | |
| PMT Controls | (2) | Serial | KB, EC, GC | 16 bits | once/orbit |
| $D_2$ lamp controls | (3) | | | | |
| Hollow cathode lamp contr. | | | | | |
| Quartz-halogen lamp contr. | | | | | |
| Motor controls | (6) | | | | |
| Premono. grating Position | | | | | |
| Main grating Position | | | | | |
| PMT scan position | | | | | |

EC = Experiment Computer
GC = Ground command from POCC
KB = SL Keyboard

Table 2.5.3-1 (Page 1 of 2)
Experiment Outputs to the CDMS

| EXPERIMENT TITLE: STAS | | DATE: April 1986 | | REVISION: None |
|---|---|---|---|---|
| **SIGNAL NAME/DESCRIPTION** | **TYPE** | **SERIAL LENGTH** | **SAMPLE RATE** | **DESTINATION** |
| Temperature 1<br>2<br>3<br>4<br>5<br>6 | Analog | 8 bits | 1/sec | SL & POCC Displays and limit monitor |
| Temp. Control 1 en/dis<br>2<br>3<br>4<br>5<br>6 | Discrete | 1 bit | 1/sec | SL & POCC Displays |
| SCIENCE DATA | | | | |
| PMT counter 1 (16 MSB)<br>PMT counter 2 (16 MSB)<br>PMT counter 1&2 (16 LSB)<br>PMT scan position<br>PMT scan error | Serial | 16 bits | 100/sec | SL & POCC |

Table 2.5.3-1 (Page 2 of 2)
Experiment Outputs to the CDMS

| EXPERIMENT TITLE: STAS | | DATE: April 1986 | | REVISION: None |
|---|---|---|---|---|
| SIGNAL NAME/DESCRIPTION | TYPE | SERIAL LENGTH | SAMPLE RATE | DESTINATION |
| ENGINEERING DATA 14 WORDS: | | | | |
| PMT Discriminator Threshold (2) | Serial | 16 bits | 1/ sec (Two analog sub-coms. 16 deep) | SL & POCC |
| PMT Control Monitor (2) | | | | |
| PMT HV Monitor (2) | | | | |
| $D_2$ Lamp Control Monitor (2) | | | | |
| $D_2$ Lamp Anode Current Mon. (2) | | | | |
| $D_2$ Lamp Filament Current Mon. (2) | | | | |
| HC Lamp Control Monitor | | | | |
| HC Lamp Current Monitor | | | | |
| Quartz Halogen Lamp Con. Mon. | | | | |
| Quartz Halogen Lamp Cur. Mon. | | | | |
| Motor Control Monitor (6) | | | | |
| Motor Position Monitor (6) | | | | |
| Motor Current Monitor (6) | | | | |
| Premono. Grating Control Mon. | | | | |
| Premono. Grating Position Mon. | | | | |
| Premono. Grating Error Monitor | | | | |
| Main Grating Control Monitor | | | | |
| Main Grating Position Monitor | | | | |
| Main Grating Error Monitor | | | | |
| Main Grating Shaft Monitor | | | | |
| PMT Scan Control Monitor | | | | |
| Low Voltage Monitors (8) | | | | |
| Temperature Monitors (18) | | | | |

## 2.6 Service Requirements

The STAS Optics Module will require continuous dry nitrogen purge at TBD $ft^3/hr$ from arrival at Kennedy Space Center (KSC) until launch, and from landing until deintegration.

The STAS will be assembled and tested in a class 10,000 clean room environment. Such an environment must be maintained throughout KSC integration, systems test, flight, and deintegration.

# 3. EXPERIMENT OPERATIONAL PROCEDURES

This section is a description of activities that must be supported by NASA-provided software such as the Experiment Computer Operating System (ECOS), the Experiment Computer Application Software (ECAS), etc.

## 3.1 STAS Test Procedures Requiring Software Support

Prior to level IV integration, all of the software needed for STAS instrument testing will be resident in the STAS EGSE and the STAS ICM; thus no NASA-provided software is required.

During levels IV, III, and II integration, the NASA-provided software and the interface between STAS and that software will be verified. NASA-provided software includes the ECAS, the ECOS software, KSC/RAU I/O Test System (HITS) test software, and the POCC software. Functions to be tested are: commanding STAS from the DDS keyboard and the POCC, operation of ECAS programs to be used by STAS, operation of POCC display driven by NASA-supplied software, operation of ECOS/ECAS driven displays for STAS data, and loading of the STAS ICM from the MMU.

## 3.2 Monitoring Requirements

The EC will be used to provide the Mission/Payload Specialist with displays containing information on STAS instrument status and some limited STAS scientific data. These data will consist of IPS status, observing mode, premonochromator or calibration lamp use, spectrometer entrance and exit slit selection, filter selection, detector selection and position, grating positions, dwell time, aperture door status, samples of detector output and critical parameters defining instrument health (which systems are on, values of critical housekeeping data such as high voltage readings, etc.). All data will be on the RAU channel.

At the POCC, NASA-supplied software is required to display the above STAS status information and limited scientific data on a standard POCC CRT display unit. These data will be on the RAU downlink. The detailed list of parameters to be monitored is TBD.

### 3.3 Operational Procedures

The in-flight operation of STAS will be controlled via commands from the Mission/Payload Specialist station or the POCC These commands will be sent to the STAS by the Spacelab EC using standard ECOS routines. STAS will accept control information in the form of serial word commands, discrete commands and alpha-numeric messages from the DDS keyboard processed by the EC. When STAS is controlled by the Mission/Payload Specialist, we anticipate that several discrete commands and alpha-numeric messages will be sent by the Mission/Payload Specialist to STAS each orbit.

An ECOS-driven display for presenting the Mission/Payload Specialist with commanding information and microprocessor messages will be required when the Mission/Payload Specialist needs to set up the instrument for performing a series of observing sequences or to modify information (e.g. grating and calibration lamp positions, integration times, etc.) stored in the microprocessor. The EC will be used to provide the Mission/Payload Specialist with displays containing information on instrument status and some limited scientific data. For these Mission/Payload Specialist displays, we expect that four formats (display pages) based on ECOS software will be required.

We will require one ECAS routine described below to facilitate transfer of information from the MMU to the 16K Random Access Memory (RAM) in the STAS ICM. We require that the RAM memory load be stored in the MMU prior to launch so that the RAM can be loaded (or reloaded if its memory is lost) in orbit from the MMU. Since some critical information or programs in the RAM memory may be updated during the mission by command from the Mission/Payload Specialist station or POCC, it is desirable that the RAM memory load stored in the MMU be capable of being updated by transfer of a RAM memory load from the STAS ICM to the MMU. It is desirable to assign space for 64K bytes of information on the MMU for this purpose with 16K for the prelaunch memory load (a load which would not be modified during flight) and 48K for three updated versions of the RAM memory load.

### 3.4 Displays

Four ECOS-driven STAS display formats for the Mission/Payload Specialist will be required; they will consist of one page for general STAS instrument status, one each for the two main operating modes (observation and calibration) and one for summarizing STAS command information One ECAS-driven STAS display format will be required to display wavelength scan

data provided by the STAS ICM. The update rate for the STAS displayed data should be once per second The detailed specification of the STAS format of this display is TBD.

At the POCC a NASA-supplied standard CRT display is required for presenting critical data on STAS instrument status, for monitoring instrument health and determining the instrument operating configuration, and for a quick-look display of scientific data. Both the instrument house-keeping data (224 BPS) and the science data (8000 BPS) for presentation in these STAS displays will be on the RAU downlink. We anticipate that the only processing of the data that will be required will be conversion of some STAS parameters to engineering units. We require three STAS display formats (which are operator selectable): one providing IPS status, observing mode, premonochromator or calibration lamp use, spectrometer entrance and exit slit selection, filter selection, detector selection and position, grating positions, dwell time, aperture door status, samples of detector output; the second format providing critical parameters defining STAS instrument health (which power systems are on, aperture door status, values of critical housekeeping data, etc.); and the third format to display science data. The science data should be displayed graphically as a spectrum, which requires a terminal with graphics capability. An update rate of once per second is ample for these displays. The detailed specifications of the format of these STAS display pages is TBD.

# 4. FACILITIES AND SUPPORT REQUIREMENTS

This section discusses the facility and support requirements for integration of the STAS Experiment. Several areas remain to be detailed later in the design stage.

## 4.1 Installation and Assembly Requirements

Installation requirements are TBD due to uncertainties associated with as yet undefined thermal and mechanical interfaces.

The STAS experiment will arrive at KSC fully assembled.

## 4.2 Special Preparation Prior to Installation of Instrument Equipment

This section describes requirements for off-line instrument checkout, test and flight preparation activities prior to payload integration

The flight equipment, EGSE and field integration crew for the STAS experiment will arrive at KSC approximately 4-6 weeks before the planned start of the level IV integration. The Harvard College Observatory (HCO) group will consist of about 10 persons (4 scientists, 3 engineers, 2 technicians and a programmer).

Upon arrival, the instrument must be unpacked in a Class 10,000 or better clean bay in the Operations and Checkout (O&C) building where it will undergo a standard functional test and calibration check. During this activity the STAS EGSE should be located in the clean area with the flight instruments.

We strongly advocate that STAS and any other instruments to be mounted on the IPS cruciform be installed and coaligned prior to level IV integration in a high bay (6-7 meters high) clean area (Class 10,000 or better). The assembly and coalignment of STAS to IPS should be accomplished at this time. Following assembly of the instruments to the cruciform, the internal alignment of the STAS instrument will be checked using an autocollimator. It is highly desirable that the RAU be mounted on the cruciform and that functional checks, through the RAU, of the cruciform-mounted instruments be performed at this time to identify any compatibility problems. Before transport to the Level IV area, the NASA-supplied thermal shroud (if such exists) should be mounted to the

cruciform and the entire assembly should be bagged to help ensure proper clean conditions (anything over Class 10,000 is highly undesirable). If no thermal shroud exists, the instrument must be individually protected by bagging and purging when in a less clean environment

Molecular and particulate contamination can render radiometric instruments incapable of collecting accurate data. For this reason final cleaning of the cruciform assembly should be performed by the HCO experimental team or, if this is not possible, it must be carried out under their immediate supervision. It would be simplest to maintain cleanliness of the cruciform assembly and the instrument support plate during the pre-level IV period when STAS is in a high-bay clean area rather than having to reestablish the necessary level of cleanliness later Having achieved cleanliness inside the thermal shroud, the open end of the shroud could be bagged before leaving the clean area for level IV integration. This bag would be removed at the last possible moment before launch.

This prelevel IV activity is estimated to take three weeks.

After the prelevel IV activity the EGSE should be moved to an appropriate control room for level IV/III/II activities.

### 4.2.1 Facility Requirements

The facility requirements for supporting off-line instrument checkout, test and flight preparation are summarized in Table 4.2 1-1.

### 4.2.2 Support Requirements

The support required for specialty laboratories, shop support and office space are summarized in Table 4.2.2-1.

## 4.3 On-Line Activities

During the level IV integration, the cruciform assembly and decoupled IPS will be mounted to a pallet or pallet train. The experiment-to-pallet electrical interface will be verified using KSC provided simulators and software. The STAS EGSE will be used to sample experiment data and to support performance verification. An experiment-test configuration of the STAS EGSE which utilizes a standard RS232 interface, will permit us to

Table 4.2.1-1
Facility Requirements
for off-line activities
at integration site

| EXPERIMENT TITLE: STAS | DATE: April 1986 | REVISION: None |
|---|---|---|

Approximate area 30 $m^2$

Ceiling height 7 $m^2$

Cleanliness class 10,000 or better

Environment: Temperature 19 to 23 °C

Humidity 40 to 60 %*

Pressure N/A to ____ $N/m^2$

Power 110/60/60 V/Hz/A
220/60/30/3Ø

Other Special Requirements TBD

* Ambient; A dry $N_2$ purge is maintained on STAS to hold internal relative humidity to less than TBD%.

Table 4.2.2-1
Office Space and Support Resources Requirements at Off-line Integration Site

| EXPERIMENT TITLE: STAS | | | DATE. April 1986 | | REVISION None | |
|---|---|---|---|---|---|---|
| SUPPORT TYPE (CHEM, OPTICAL, SHOP, ETC) | EXPERIMENT ACTIVITY AND EQUIPMENT | TIME (h) | POWER V/Hz/W | SPECIAL EQUIPMENT | SPECIAL FLUIDS/GASSES | OTHER |
| Class 10,000 clean room with area that can be darkened for stray light control. | Radiometric Calibration<br><br>Calibration fixture calibration lamp and Power Supply | 16 | 110/60/6600<br>220/60/6600 | Whatever to create dark area | Dry $N_2$ | None |

OFFICE SPACE AND EQUIPMENT ARE REQUIRED FOR 10 PERSONNEL

bypass the RAU in the event that difficulty is encountered. In addition to direct command capability, this arrangement will provide readouts of the basic instrument functional parameters. It will also be possible to command STAS through the RS232 and observe the results on the RAU data stream

During Level III/II the full Spacelab payload will be assembled. The flight DDS will be connected and the CDMS will be completed with the flight EC and MMU. The RS232 interface of the STAS EGSE can be used at this stage in the way described for level IV Integration.

A series of tests will be defined to functionally verify the Spacelab-to-Payload interfaces by loading and operation of the STAS ICM software and NASA-supplied software, and functional verification of all interfaces.

The second phase of level III/II integration will be done in the Cargo Integration Test Equipment (CITE) stand. All flight systems for Spacelab will be used at this stage including the actual RAU, EC, MMU and DDS. To support simulated Orbiter-to-Spacelab testing, the STAS will be exercised through the critical operational steps required for STAS observations. This may require participation of the Mission/Payload Specialist.

#### 4.3.1 Equipment Handling and Installation Precautions

A description of experiment handling and installation precautions to be observed during handling and installation is TBD. Keeping the STAS experiment free of molecular and particulate contamination through all activities is critical (see Section 4.2).

#### 4.3.2 Special Test, Alignment, Calibration Servicing, and Maintenance Requirements

It is necessary to radiometrically calibrate the STAS instrument periodically and just prior to the mission. Final calibration must be performed within a few days of launch. There will be a calibration fixture which attaches to the front (sun end) of the instrument to properly position standard light sources in the field of view. With a source on, the instrument will be commanded to perform wavelength scans and the photomultiplier responses will be recorded. During such calibration the instrument will be purged with dry nitrogen or argon at an increased rate to minimize atmospheric absorption.

### 4.4 NASA-Provided Support Equipment

It is not anticipated now that any NASA-provided support equipment will be required.

Table 4.4-1
Ground Support Equipment Requirements

| EXPERIMENT TITLE: STAS | | | | | DATE: April 1986 | | REVISION: None | |
|---|---|---|---|---|---|---|---|---|
| EQUIPMENT ITEM | FACILITY REQUIREMENTS | | | | | INTERFACES | | SPECIAL REQUIREMENTS |
| | AREA (SQ M) | POWER VOLTS/AMPS | FLUIDS OR GASES | CLEANLINESS LEVEL | TEMP/ HUMIDITY | INTEGRATION SITE GSE | EXPERIMENT FLIGHT HDW | |
| EGSE<br>#1 Rack<br>#2 Rack<br>#3 CRT<br>1/0 Terminal<br>#4 Printer | $15M^2$ | Three 110V, 1$\phi$, 60 Hz 20 amp circuits<br><br>One 220V, 3$\phi$, 60 Hz 30 amp circuit | Filtered dry nitrogen | | 19 to 23°C<br><br>40 to 60% relative | Test cable from EGSE in control room to STAS on Spacelab assembly floor; about 50 wires and 500 ft. long. | | TBD |
| Calibration Fixture<br>#1 Source<br>#2 Power Supply | $4M^2$ | | | Class 10,000 | | | | |

# 5. PREFLIGHT OPERATIONS REQUIREMENTS

This section covers those activities during the final countdown from post-level I through launch

Until we have a detailed NASA description of post-level I activity, it is not possible for us to be specific about the preflight operational requirements for the STAS.

## 5.1 Access Requirements

None known at this time.

## 5.2 Special Support Requirements

We expect prior to launch to check telemetry signals from KSC to POCC at Johnson Space Center (JSC) and to hold detailed checkout by STAS launch crew at KSC during final countdown.

# 6. FLIGHT REQUIREMENTS

This section covers those activities performed on-orbit in support of the STAS experiment.

## 6.1 Operating Modes

The STAS instrument has non-observing modes and observing modes as described below.

LAUNCH AND RE-ENTRY (Mode 1): In the LAUNCH AND RE-ENTRY mode the front aperture cover is closed and no power is applied to STAS.

POWER-DOWN (Mode 2): In the POWER-DOWN mode, the STAS front aperture cover can be commanded open or closed, power is supplied to the ICM to preserve its RAM, housekeeping outputs are available to telemetry, the thermal control system is on, the drives are off, and the detector electronics are off.

ON-ORBIT STANDBY (MODE 3): In the ON-ORBIT STANDBY mode, the STAS front aperture cover is commanded open or closed, the thermal control system is operating, and most electronics are on (although individual functions such as high voltage to either detector would be off).

OBSERVING (Mode 4): In the OBSERVING mode, the front aperture cover is open and generally all electronics are on (although individual functions, such as high voltage to either detector can be turned off). STAS observes according to programmed sequences, and STAS outputs both science and housekeeping data continuously.

CALIBRATION (Mode 5): In the CALIBRATION mode, which is usually done during the night portion of the obits, the front aperture cover can be commanded open or closed and generally all electronics are on, any of the calibration light sources can be excited although individual functions such as high voltage to sources or to either detector can be turned off. STAS performs calibration according to programmed sequences and STAS outputs both science and housekeeping data continuously.

Table 6.1-1
Instrument Operating Mode Requirements

| EXPERIMENT TITLE. STAS | DATE. April 1986 | REVISION: None |
|---|---|---|

| Parameter | Mode 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Power (watts) | Launch & Re-Entry | Power-Down | On-Orbit Standby | Observing | Calibration |
| 28 V Bus instrument | 0 | 10 | 25 | 126 | 176 |
| 28 V Bus Heaters | 0 | 30 | 30 | 20 | 40 |
| 400 Hz Bus | - | - | - | - | - |
| Digital Data Downlink Rate (bits/sec) | 0 | 235 | 235 | 8,235 | 8,235 |
| Analog Data (Downlink) Bandpass (kHz) | -- | -- | -- | -- | -- |
| Video Downlink Required (Yes or No) | No | No | No | No | No |
| Typical duration of mode (minutes) | N/A | TBD | TBD | 50 | 25 |
| Number of cycles of mode required to achieve objectives | 2 | TBD | TBD | 100 | 100 |

Table 6.1-2
Pointing Performance Requirements

| EXPERIMENT TITLE: STAS | | | | | | | | | DATE: April 1986 | REVISION: None |
|---|---|---|---|---|---|---|---|---|---|---|
| MODE OR OPERATIONAL STEP | TARGET | POINTING ACCURACY (ARC-SEC) | | TRACKING ACCURACY (ARC-SEC) | POINTING STABILITY (ARC-SEC) | | STABILITY DURATION (SEC) | STABILITY RATE (ARC-SEC/SEC) | | |
| | | LOS | ROLL | | LOS | ROLL | | | | |
| 1 (Launch) | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | | |
| 2 (Power-down) | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | | |
| 3 (Standby) | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | | |
| 4 (Observing) | Sun-Center | 120 | ↓ | 120 | 120 | ↓ | 3600 | 60 | | |
| 5 (Calibration) | N/A | N/A | ↓ | N/A | N/A | ↓ | N/A | N/A | | |

Table 6.1-3
Pointing Service Requirements

| EXPERIMENT TITLE STAS | | | | | DATE. April 1986 | | REVISION None | |
|---|---|---|---|---|---|---|---|---|
| MODE OF OPERATIONAL STEP | KNOWLEDGE OF POSITION (DEG OR ARC SEC) | RASTER SCAN REQUIRED YES/NO SIZE ? | SLEW RATE MAXIMUM REQUIRED ARC SEC/SEC | SETTLING TIME (SEC) | ORBITER POSITION ACCURACY | | | |
| | | | | | ALTITUDE (METERS) | VELOCITY (± METERS/S) | DOWNRANGE KM | CROSSRANGE KM |
| 1 (Launch and Re-Entry) | N/A → | | | | | | | |
| 2 (Power-down) | N/A → | | | | | | | |
| 3 (On-Orbit Standby) | Know if sun pointed or not | N/A → | | | | | | |
| 4 (Observing) | 2 arc sec or standard IPS data | No | N/A | 30 sec | 400 M | ±200 M/S | 1 KM | 1 KM |
| 5 (Calibration) | N/A → | | | | | | | |

## 6.2 Targets and Viewing Constraints

The STAS scientific target area is the solar center with an accuracy ± 120 arc sec. Orbiter attitude during STAS observing modes must be such that no vehicle structural component or other object can specularly scatter either solar disk radiation or backscattered radiation from the terrestrial atmosphere into the STAS apertures.

The larger instantaneous FOV of STAS seven degrees by one degree (full angle).

## 6.3 Ancillary Parameter Requirements

In order to interpret the scientific data of the STAS experiment, ancillary data must be incorporated into our transmission via the RAU We will require real-time knowledge of universal time, IPS coordinates and STAS attitude parameters. We also need real-time knowledge of the times when sunrise and sunset occur as well as when overboard dumps, flash evaporations, and thruster firings take place. These latter events should be time-lined so that the STAS instrument is in a safe condition when they occur. The STAS ancillary parameter requirements are summarized in Table 6.3-1.

## 6.4 Flight Environmental Sensitivity Limits

The STAS instrument is sensitive to the contaminate environment of the Orbiter bay. The details of the contamination requirements will be provided in the future. A preliminary idea of the STAS requirements are provided in Table 6.4-1. It is anticipated that overboard dumps, flash evaporations, and thruster firings should not occur just prior to or during STAS observations.

## 6.5 Vehicle Motion Limits

The disturbance introduced by the vehicle due to its thruster firings or the crew motion shall not overload the IPS capability to the extent that the final pointing stability of 60 arc seconds/second would be jeopardized Table 6.5-1 provides an indication of the limiting values respectively for STAS.

Table 6.3-1
Ancillary Parameter Requirements

| EXPERIMENT TITLE: STAS | DATE: April 1986 | REVISION None |
|---|---|---|

| PARAMETER | ONBOARD | POSTMISSION |
|---|---|---|
| Absolute time, UTC (millisec) | 1000 | 1000 |
| Orbiter Position (meters) | 1000 | 1000 |
| Orbiter Velocity (m/sec) | 200 | 200 |
| Orbiter Attitude (deg) | 1.0 | 1.0 |
| Other (describe) | IPS Attitude (see Table 6.1.3) | |

GN&C DATA REQUIREMENTS

| | | | | |
|---|---|---|---|---|
| State Vector | Yes X | /No | AM50* | /GTOD** X |
| Current Attitude | Yes X | /No | AM50 | /GTOD X |
| Orbiter Body Rates | Yes X | /No | | |

* Aries Mean of 50
** Greenwich True of Date.

Table 6.4-1
Flight Environment Limits

| EXPERIMENT TITLE. STAS | | | | | DATE April 1986 | | REVISION. None | |
|---|---|---|---|---|---|---|---|---|
| | SENSITIVITY LIMIT | | | | EXPERIMENT GENERATED | | | |
| | OPERATING | | NON OPERATING | | OPERATING | | NON-OPERATING | |
| | MIN | MAX | MIN | MAX | MIN | MAX | MIN | MAX |
| 1. HIGH ENERGY RADIATION (rad) | - | $10^3$ at electronics | - | $10^3$ at electronics | N/A | → | → | → |
| 2 ELECTROMAGNETIC RAD ($W/m^2$ @Hz) | Note 1 | | | | N/A | → | → | → |
| 3. EMI CONDUCTED (V @Hz) | Note 1 | → | → | → | → | → | → | → |
| 4 MAGNETIC (TESLA) | - | $10^{-4}$ | - | $10^{-3}$ | N/A | → | → | → |
| 5 ACOUSTIC RADIATION ($N/m^2$) | - | N/A | - | 170 | N/A | → | → | → |
| 6 MECHANICAL VIBRATION ($g^2/Hz$) | - | TBD | - | Note 2 | N/A | → | → | → |
| 7 PRESSURE ($N/M^2$) | hard vacuum | $2x10^5$ | hard vacuum | $2x10^5$ | N/A | → | → | → |
| 8 CONTAMINATION, MODULE ITEMS | | | | | | | | |
| A PARTICULATE SIZE ($\mu m$), NUMBER/$m^3$ | - | TBD | - | TBD | → | → | → | → |
| B TRACE GASES (TYPE & PPM) | - | TBD | - | TBD | → | → | → | → |
| C. Molecular ($ng/Cm^2$) | - | TBD | - | TBD | → | → | → | → |
| 9. LIGHTING (LUX) | - | TBD | - | TBD | N/A | → | → | → |
| 10 MAX INTERNAL ANGULAR MOMENTUM | - | TBD | - | TBD | N/A | TBD | N/A | N/A |

Note 1: STAS will be designed and tested for electromagnetic behavior in accordance with the NASA/GSFC document, "General Environmental Verification Specification for STS Payloads, Subsystems, and Components", GEVS-STS, Sept. 1984.
Note 2: STAS will be designed and tested to withstand the vibration environment specified in the "Spacelab Payload Accommodation Handbook", SLP/2104, Aug. 1985

Table 6.5-1
Vehicle Motion Parameter Limits

| EXPERIMENT TITLE: STAS | | DATE: April 1986 | REVISION: None |
|---|---|---|---|
| | | SENSITIVITY LIMIT | |
| | | OPERATING | NON-OPERATING |
| 1. | RECTILINEAR ACCELERATION ($m/sec^2$) | Set by response capability of tracking system and pointing adjustment system to maintain sun center pointing performance as required in Table 6.1-2 | N/A |
| 2. | ACCELERATION RESULTING FROM VEHICLE ROTATION ($m/sec^2$) | | |
| 3. | NET ACCELERATION (NOT NECESSARILY SUM OF ITEMS 1 AND 2 ABOVE ($m/sec^2$) | | |
| 4. | ANGULAR ACCELERATION ($rad/sec^2$) | | |
| 5. | ANGULAR VELOCITY (rad/sec) | | |

### 6.6 Payload Specialist Requirements

The STAS instrument can be controlled by the Mission/Payload Specialist through the Spacelab EC. Information on instrument status, operating mode and type of data being obtained will be provided via the Data Display System (DDS). The ICM in the STAS can store (on command) selected types of observational data. These data can be called up by the Mission/Payload Specialist for display on the DDS. All instrument functions and operating modes necessary for operation of the STAS instrument will be accessible by command from the DDS. The software in the EC will be coupled to the ECOS/ECAS software in a manner designed to minimize the commanding required to control the STAS instrument. The Mission/Payload Specialist will be provided with a manual containing a description of STAS observing programs and instrumental modes, commands needed to implement these modes, and other information required to run the STAS experiment so that he/she can operate independently of ground contact if necessary. Normally we expect that the daily observing program will be planned by the HCO scientific team in the POCC where they will be performing quick-look analyses of the data in order to optimize the daily observing program. The degree to which the daily observing program follows the program planned prior to launch (and contained in the Mission/Payload Specialist manual) will depend on the state of solar activity during the flight, instrumental performance in flight, availability of observing time, etc. The scientific team will notify the Mission/Payload Specialist via the voice link of the selection of instrumental modes to be run.

The Mission/Payload Specialist will perform the STAS instrument checkout, point the instrument, and command the STAS to perform the appropriate observing sequences. The observing plan will normally be developed by the Science Team at the POCC, however, this observing plan may be modified by the Mission/Payload Specialist because of changing solar conditions, unexpected changes in the daily flight plans, etc. The Mission/Payload Specialist will require sufficient training in the scientific objectives of the experiment so that he/she can make decisions to modify the preplanned observing program when necessary. This will require a minimum TBD hours of instruction by the STAS team supplemented by STAS-supplied documentation on the scientific observing program and objectives. Specialized training in solar physics is not required for operation of the STAS instrument.

It is highly desirable that the Mission/Payload Specialist spend a sufficient amount of time acquiring hands-on experience with control of the STAS flight instrument to thoroughly familiarize himself/herself with the

instrumental operating characteristics.

We anticipate that a minimum of TBD hours of effort will be required for the Mission/Payload Specialist to familiarize himself/herself with the STAS instrumental operating characteristics via documentation provided by the Principal Investigator (PI). This documentation should be supplemented by several meetings between the Mission/Payload Specialist and PI team (either at HCO or at JSC).

## 6.7 Special Support Requirements

There are no plans for crew Extra Vehicular Activity (EVA) or Remote Manipulator System (RMS) activities for the STAS.

The only requirement for real-time processing of STAS data (other than the processing performed by the EGSE) is the processing required to read out and display at the POCC the STAS instrument status and science data contained in the RAU downlink (see Section 3.3). This data will be captured and manipulated by the STAS specific EGSE. The only processing required for processing real-time STAS data outboard is that required to read and display the data sent to the RAU by the experiment for ECOS and ECAS driven displays. There is also a requirement for 64K bytes of storage on the experiment computer MMU for storing a memory load for the STAS ICM.

Office space requirements for the HCO personnel as well as the floor space required for STAS Ground Support Equipment (GSE) will be finalized during the detailed design phase but we estimate needing 25-35% of a standard POCC room.

In addition, a telephone link with ground-based solar observatories should be provided, as required, to ensure an optimum observing program.

# 7. POSTFLIGHT EQUIPMENT REQUIREMENTS

## 7.1 Access Requirements

None

## 7.2 Deintegration Requirements

It is understood that after the STS lands and the Orbiter returns to the Orbiter Processing Facility (OPF), a team of NASA and contractor personnel will be standing by to remove the Spacelab from the Orbiter. HCO will have representatives on hand to observe this operation

The STAS Optics Module will require continuous dry nitrogen purge at TBD $ft^3/hr$ from landing until deintegration STAS will be tested and disassembled in a Class 10,000 clean room environment. Such an environment must be maintained throughout deintegration.

The Spacelab payload will then be transported to the level IV integration site for disassembly from the main structure. The STAS experiment will be removed from the pallet with the support of HCO personnel acting in the capacity of observers and assistants. A simplified systems test will be conducted to evaluate the experiment condition. Then, the flight instrument will be installed in the shipping container and returned to HCO for subsequent test, final sensitivity calibration, and evaluation.

Table 7.2-1 provides the requirements for the postlanding disposition of the STAS experiment.

Table 7.2-1
Post Landing Experiment Requirements

| EXPERIMENT TITLE. STAS | | DATE: April 1986 | REVISION: None |
|---|---|---|---|
| EQUIPMENT ITEM | STORAGE OR SHIPPING ENVIRONMENT | SHIPPING CONTAINER | CONSIGNEE AND ADDRESS |
| 1 (Optics Module)<br>2 and 3 (Electronics A & B) | Environmentally-controlled air-ride van ground shipment | A shipping container with shock isolation and filtered dry $N_2$ purge is provided | Dr. William H. Parkinson<br><br>Center for Astrophysics<br><br>60 Garden St.<br>Cambridge, MA 02138 |

## LIST OF ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| AFD | Aft Flight Deck |
| CITE | Cargo Integration Test Equipment |
| CDMS | Command and Data Management System |
| DDS | Data Display System |
| EC | Experiment Computer |
| ECAS | Experiment Computer Application Software |
| ECOS | Experiment Computer Operating System |
| EGSE | Electronic Ground Support Equipment |
| EVA | Extra Vehicular Activity |
| FOV | Field of View |
| GSE | Ground Support Equipment |
| HCO | Harvard College Observatory |
| HITS | High Rate Multiplexer Input Output Test System |
| I/O | Input Output |
| ICM | Instrument Controller Microprocessor |
| IPS | Instrument Pointing System |
| JSC | Johnson Space Center |
| KSC | Kennedy Space Center |
| MMU | Mass Memory Unit |
| OC | Operations and Checkout |
| OPF | Orbiter Processing Facility |
| POCC | Payload Operations Control Center |
| PMT | Photomultiplier tubes |
| PI | Principal Investigator |
| RAM | Random Access Memory |
| RAU | Remote Acquisition Unit |
| RMS | Remote Manipulator System |
| ROM | Read Only Memory |
| STAS | Solar and Terrestrial Atmospheres Spectrometer |
| TBD | To Be Defined |